The Demand for Primary Schooling in Madagascar: Price, Quality, and the Choice Between Public and Private Providers

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Abstract

We estimate a discrete choice model of primary schooling and simulate policy alternatives for rural Madagascar. Poor households are substantially more price-responsive than wealthy ones, implying that fee increases for public schools will have negative effects on equity in education. Among quality factors, multigrade teaching (several classes being taught simultaneously by one teacher) has a strongly negative impact on public school enrollments. Simulations indicate that providing teachers to reduce by half the number of multigrade classes in public schools would lead to modest improvements in overall enrollments, would be feasible in terms of costs, and would disproportionately benefit poor children. In contrast, consolidation of primary schools combined with quality improvement would be ineffective because of the negative effect of distance to school. Other simulations point to limits to a strategy of public support for private school expansion as a means of significantly increasing enrollment rates or education quality; such an expansion may also reduce overall education equity.

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I. INTRODUCTION

The provision of free or largely subsidized primary education is among the most important and widely accepted functions of governments in developing countries. In Africa, however, after impressive successes following independence, governments have faced increasing challenges to fulfilling this function. In part as a consequence of economic stagnation and decline beginning in the early 1980s, public education systems in African countries have suffered from severe revenue shortfalls during a time when the school-age population has grown rapidly. Inevitably, quality has deteriorated in public schools, which together with falling household incomes has left many countries far from achieving basic goals of universal primary enrollment or literacy. At the same time, growing dissatisfaction with the public education system has led to a rise in the demand for private schooling.

Faced with these trends, governments must attempt to meet several important but potentially conflicting objectives: to improve school quality, to restore or increase enrollment levels, and to insure that public spending on education is progressive (or 'pro-poor'). The potential conflicts are well illustrated by the controversy generated by proposals to impose fees or increase current fee levels in public schools. These strategies for cost-recovery may make it easier for governments to invest in much needed quality improvements or new school construction, but serious equity concerns have been raised: will the higher costs impinge the most on enrollments of the poor?

A complicating factor for policy (and analysis) is the presence of a private sector in education. Substitution between public and private school alternatives will influence the outcomes of education policies even when these policies are implemented only in public schools. For example, the negative enrollment impacts of public school fee increases may be offset by increased private enrollments. At the same time, the goal of the price increase, to raise revenue for the public schools, will be confounded by the exodus of fee-paying students from the public sector.

Private providers may be of superior quality, suggesting that policies to encourage the development of the private sector in education will improve overall human capital outcomes. However, discussion of private schooling, as with school fees, inevitably invokes concerns over equity. The poor may not be able to afford better quality private schools; alternatively, the private option may simply not be available in areas where the poor live. Either factor will limit the ability of poor households to take advantage of potentially higher quality private alternatives. If they are effectively priced out of the private sector, the poor will not benefit from its growth, which instead may exacerbate existing inequalities in the distribution of schooling or school quality, and thus also in the distribution of economic opportunity and welfare. On the other hand, if the poor do not participate in the private education sector primarily because they do not have access to local private schools, government support of private school expansion may actually benefit them disproportionately, with very different consequences for equity in the distribution of public expenditures, school enrollments, and education quality.

The issue is important in light of the increasing interest in the private sector as a means of filling the gaps in the public delivery of education services, especially where resource limitations make a major expansion of public education infeasible or where the quality of public services is poor. Although a number of studies for developing countries have examined the role of price and quality in schooling decisions, very few have looked at how these factors influence the choice between public and private school alternatives, or explicitly considered the implications of the growth of the private sector in education.[1] Further, few have attempted to compare outcomes of alternative policies with respect not just to schooling outcomes but also to the costs to the public sector (for example, to add teachers or construct schools). We do this in the present study, using a detailed household dataset from Madagascar that is complemented by community level data on the characteristics of local schools. We estimate the effects of changes in price and school characteristics on the primary schooling decisions of rural households, incorporating the private sector as an alternative to public schools.

In addition, we clarify analytically the relationship between price elasticity estimates obtained from demand models and changes in the benefit (school enrollment) shares of different quantiles of the income distribution. We use the demand model estimates to simulate the impacts of changes in public school fees and other education policies on public as well as private primary enrollments and their distribution, as well as the costs to the public sector of each alternative. On the quality improvement side, we focus on the provision of additional teachers and classroom construction in public schools (with and without cost recovery) to reduce the need for multigrade teaching, a widespread practice in Madagascar and other developing counties whereby a single teacher must teach two or more classes at once. We simulate as well an alternative policy of school consolidation under which some rural schools are closed and the cost savings are used to improve the quality of nearby schools. We also consider the enrollment, distributional, and budgetary impacts of subsidizing the construction of private primary schools to rural areas not currently served by them.

The paper is organized as follows. The next section describes the empirical strategy. Section III describes the institutional background and the data, and Section IV presents the results of the estimations and policy simulations. Section V concludes with a discussion of the policy implications of the results.

II. MODEL AND EMPIRICAL SPECIFICATION

Model of School Choice

As usual, parents are assumed to derive utility from the human capital of their children, which is a function of their schooling, and from consumption of other goods and services. Faced with the three alternatives of enrollment in public school, enrollment in private school, and non-enrollment, parents choose the alternative that brings the highest utility. Define Y_i as household income and P_{ij} as the costs to the household of choosing schooling option j (inclusive of fees and

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[1] Alderman et. al. (2001) and Younger (1999) are among the few developing country studies of schooling that analyze public-private choice.

other direct expenses as well as the value of the forgone household or farm production of the child if j is chosen). Consumption net of schooling is therefore $(Y_i - P_{ij})$ if j is chosen. Also let S_{ij} be the increment to the child's human capital associated with a year's enrollment in this school alternative. Perhaps the most frequently used functional form to represent utility is that proposed by Gertler et. al. (1987), who enter net consumption as a quadratic, i.e., for option j, $V_{ij} = a_0 S_{ij} + a_1(Y_i - P_j) + a_2(Y_i - P_j)^2$. The quadratic specification yields an interaction of income and price, thereby permitting the effects of price, and price elasticities, to vary with income. We employ a variant of this approach, by interacting net consumption with dummy variables indicating the per capita expenditure quintile of the household:

$$V_{ij} = a_0 S_{ij} + a_1(Y_i - P_{ij})E_1 + \dots \; a_5(Y_i - P_{ij})E_5 + e_{ij} \tag{1}$$

where e_{ij} is a random disturbance term. The dummy variable E_k (k =1,..,5) equals 1 if the expenditure per capita of the individual's household falls in quintile *k* and zero otherwise. Through the coefficients on the interactions the model permits separate price responses for each expenditure quintile. This specification is more flexible than the simpler quadratic form in terms of allowing non-linearities in the effects of income on price responses, and it has the additional advantage of conforming well to our simulation exercises in which we consider the effects of policies by expenditure quintile.

The increase in human capital, S_{ij} is expected to vary across school options (one of which is no school at all), primarily because the quality of the alternatives may differ. Since this change is not directly observed, $a_0 S_j$ is replaced by a reduced form equation for the utility from human capital:

$$a_0 S_{ij} = \gamma Q_j + \delta_j X_i + n_{ij} \tag{2}$$

where Q_j is a vector of school quality variables and X_i is a vector of observed household and individual characteristics. Many of these factors (e.g., parental education) affect utility both through the production of human capital and through direct effects on preferences for schooling or human capital. Substituting into (1) (and making the notation for the quintile-consumption interactions more compact) yields

$$V_{ij} = \gamma Q_j + \delta_j X_i + \Sigma_k a_{1k}(Y_i - P_j)E_k + \varepsilon_{ij} \tag{3}$$

where $\varepsilon_{ij} = e_{ij} + n_{ij}$.

The household chooses the schooling option j that yields the highest utility, that is, for which $V_{ij} > V_{ik}$, all $j \neq k$. As is well known, since this decision rule involves only differences in conditional utilities rather than levels, variables in X_i that do not differ across options would not affect choice unless their effects were allowed to vary across options. Hence the δ_j are indexed on the alternative.

The specification developed so far is fairly standard, including with respect to the imposition of several key restrictions on the parameters. The formulation of utility as a function of household consumption net of schooling $(Y_i - P_j)$ imposes the restriction that the coefficient on income is the same (times -1) as that on price. In the equation above this 'net consumption restriction' is imposed for each quintile, reflected in the a_k terms in (3). Note as well that these coefficients are constrained to be the same across alternatives; i.e., there is no indexing of a_k on j. However, in our estimations our starting point is a more general specification that relaxes these restrictions,

$$V_{ij} = \gamma Q_j + \delta_j X_i + \Sigma_k \alpha_{1jk} Y_i E_k + \Sigma_k \alpha_{2jk} P_j E_k + \varepsilon_{ij} \tag{4}$$

The coefficients on Y_i terms (α_{1jk}) differ from the price coefficients (α_{2jk}) for each quintile and both they and the price coefficients are indexed on j. In their influential study Gertler et. al. (1987) criticized earlier approaches that did not impose the cross equation restriction as being inconsistent with the basic postulates of utility maximization.[2] As noted more recently by Dow (1999), however, alternative-specific price effects would result from relaxing the assumption of separability in the utility function (between schooling and other consumption in the present case), so this restriction should be tested rather than imposed.[3] With regard to the within equation restriction relating the income and price parameters, one situation where this restriction would not apply was originally suggested by McFadden (1981) and arises from the presence of unmeasured tastes that affect utility from an alternative and are also systematically related to household income. In Appendix 1 we present a formal derivation and show that this leads to a more general model that nests equation (3). As described in the appendix, a likelihood ratio test rejects the restrictions imposed by the latter. Therefore the general specification (4) is preferred.

Given the functional form for conditional utilities and the decision rule, we can derive the demand functions, that is, the probabilities of choosing each school option, once we make an assumption about the functional form for the disturbances. As in many previous provider choice

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[2] If the a_1 were allowed to vary across alternatives, it would be possible for two alternatives with the same utility from schooling $\gamma Q_j + \delta_j X_i$ and the same level of other consumption $(Y_i - P_j)$ to yield different levels of utility.

[3] The simple additively separable structure of utility is evident in the standard formulation we present. One way separability can be violated, suggested by a referee, is if other home goods and school inputs are complements to the production of human capital (recall that the utility function incorporates the production function) and the elasticity of complementarity between school and home inputs differs across private and public schools. Note that relaxing the cross equation restrictions by allowing non-separability does not imply that the net consumption restriction relating income and price is also invalid, though we present an argument for relaxing this restriction as well in the appendix.

studies we estimate the probabilities as nested multinomial logits, a generalization of the multinomial logit model that allows error terms to be correlated across alternatives within a subgroup of choices. The nesting structure we adopt assumes that the error terms of the schooling choices, which in the present case consist of public school and private school, are correlated. An additional, less typical, aspect of our estimations is that the probability expressions are adjusted to accommodate the fact all individuals do not have the same number of schooling options from which to choose; specifically, a majority lack a private school alternative. Observations with both options available contribute to the identification of the parameters of the public and private school conditional utility functions while observations with only public school help identify the public school parameters only.

Policy Simulations

We use the estimates of the school choice model to simulate the effects on primary school enrollments of the alternative education policies described in the introduction. Since a major objective is to assess the distributional aspects of these policies, it is important to carefully define what we mean when we say that a particular policy is beneficial or harmful to the poor relative to the non-poor. For our analysis we distinguish two ways of measuring these distributional effects. We illustrate the concepts using as an example a change in school fees.

Many econometric demand studies (e.g., Gertler et. al., 1987) base their discussions of the distributional implications of changes in fees on comparisons of price elasticities of the "poor" and the "rich", i.e., lower and upper income quantiles. Here we make explicit the connection between elasticities and the distribution of benefits, which we will define in terms of quantile shares in aggregate enrollments. Many studies find that price elasticities are higher for low-income households, which means that the poor's reduction in demand from a given percentage increase in price will be greater in proportional terms than that of the rich. Proportionately larger reductions in demand (enrollment) in turn mean that the share of the poor in total enrollments falls—in other words, the incidence of primary schooling becomes less progressive in the usual fiscal incidence sense. Formally, define E_j as the enrollments of the *j*th quantile and E as total enrollment (so *j*'s benefit share is E_j/E), e_j as the price elasticity of the *j*th quantile and *e* as the overall or average price elasticity, and P as the price level. It is straightforward to show that the change in the benefit share for quantile *j* resulting from a change in the price is:

$$\textit{change in benefit share} = \frac{\partial \left(E_j/E \right)}{\partial P} = \frac{1}{P}\left(\frac{E_j}{E} \right)(e_j - e)$$

The elasticity of the share with respect to price is simply $e_j - e$. Hence *j*'s new benefit share after the price increase will be less than its initial share if e_j exceeds (in absolute value) the average elasticity. Therefore the comparison across income quantiles of the elasticities derived from behavioral models permits (inferential) comparisons of the distribution of benefits before and after a price change or other policy.

The foregoing involves the comparison of average benefit shares before and after the policy is implemented—it shows how the targeting of benefits to the poor changes as a result of a policy. However, we also are likely to be interested in the *marginal* shares, i.e., the quintile shares in the aggregate increase or decrease in school enrollments resulting from the policy. Do lower income quintiles incur a disproportionate share of the reduction (or increase) in benefits? For this the relevant indicator is what we will call the "relative marginal share", equal to the change in enrollments of quintile *j* over the mean quintile change in enrollments:

$$relative\ marginal\ share = \frac{\partial E_j/\partial P}{\left(\dfrac{\partial E/\partial P}{k}\right)}$$

where *k* is the number of income quantiles (e.g., 5). If this ratio equals unity, *j* incurs an exactly proportional share of the aggregate gains or losses, while values less than (greater than) one imply disproportionately small (large) gains or losses. This measure is distinct from the change in the average benefit shares described above; in fact, it can easily lead to an opposing assessment of distributional outcomes. For example, consider a situation in which the initial incidence of the benefit is highly regressive, so that the share going to the bottom quantiles is very low. It would not be hard in this case for a program expansion to yield an increase in these quantiles' average benefit shares (a rise in E_j/E) even if the distribution of the marginal benefits strongly favors the non-poor (i.e., the relative marginal shares for the poorest quintiles are less than 1). Intuitively, when initial benefit levels for the poor are low, even small absolute increases can mean large proportional increases, which will tend to raise the share of this group in the total benefit.[4] We would not consider the benefits of such a program expansion to be well targeted to the poor, even if the average incidence becomes more progressive. Therefore it is important to examine the marginal quantile shares, not just the change in the average shares, when assessing the distributional effects of policies.[5]

For the simulations reported in this paper, therefore, both criteria will be considered. In reporting the quintile shares (and changes in them), we define the quintile in which an individual is located using the distribution of per capita household expenditures for the national Madagascar sample. However, since rural areas tend to be poorer than urban areas, the lower expenditure quintiles are disproportionately represented in our rural sample, i.e., each makes up

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[4] Formally, quantile *j*'s average share will rise as long as its marginal share exceeds its average share. To see this, recall that the condition for an increase in *j*'s share is that $e_j > e$. Using the formulas for elasticities and rearranging terms, this can be expressed as $\dfrac{\partial E_j/\partial P}{\partial E/\partial P} > \dfrac{E_j}{E}$: *j*'s share increases if its share of the marginal benefits exceeds its average, or initial share. The point raised in the text is that when *j*'s average share is low, this is a weaker condition than that *j* receives a disproportionate share of the marginal benefits.

[5] We should point out that disproportionate enrollment reductions for the poor do not imply that a price increase or other policy is "regressive" in the sense that the welfare loss would be larger for poorer households than rich households. In fact, greater responsiveness to price on the part of the poor would suggest smaller (absolute) consumer surplus losses for the poor from a price increase (Dow, 1995). Our focus is on the distribution of enrollments, not household welfare.

more than 20% of the observations. In addition, since we are considering schooling, it is arguably more sensible to relate the benefit shares to the quintile shares of school-age children rather than shares of the total population. The child population is not evenly distributed across quintiles, however, since poor families tend to have more children than non-poor families do. We make an adjustment for both of these factors by calculating the ratio of the share of each quintile in overall (rural) enrollments to the quintile's share of the (rural) primary school age population. Thus for the share of the jth quintile we calculate $\dfrac{E_j/E}{N_j/N}$, where N is the total rural population and N_j is the number of rural primary age children belonging to quintile j. This ratio equals one if the portion of rural enrollments accounted for by the quintile is the same as its share of the rural school age population; it is less than (greater than) one if the quintile's share of enrollments is less then (greater than) its population share. Note that this measure can be defined equivalently as the quintile specific enrollment rate divided by the overall enrollment rate. For marginal shares the analogous measure is $\dfrac{\Delta E_j/\Delta E}{N_j/N}$; the notation reflects the fact that the simulations involve discrete changes in enrollments. The relative marginal share measure defined earlier is a special case of this measure for which N_j is the same for all k quantiles, so that N_j/N equals 1/K.

III.   Institutional Background and Data

The education sector in Madagascar

Madagascar realized impressive gains in expanding access to schooling after independence in 1960, when education was made free for all children. Gross primary enrollment rose from 50 percent to well over 100 percent by the early 1980s (World Bank, 1996). After the early 1980's, however, enrollments began to decline at all levels, and particularly for primary school. Gross primary enrollments fell from about 140 percent in 1980 to less than 80 percent in 1993/4. One reason for this was the country's overall economic decline and the consequent rise in poverty during the period. Another probable, and related, factor was the deterioration in the quality of public schools, a reflection of the inadequate and (from the late 1980s though mid-90s) falling share of education in the government budget (World Bank, 1996). Judging by efficiency indicators such as repetition and dropout rates (cited in World Bank, 2002), the quality of schooling in Madagascar is indeed poor both absolutely and in relation to other countries in the region.

The private sector in education, while still relatively small, has been expanding steadily, apparently in response to dissatisfaction with the quality of the public system. There is evidence from panel data on test scores that quality is higher in private schools (Lassibille and Tan, 2003). An important characteristic of private primary schooling in Madagascar, as in many other African countries, is that it is dominated by church-run (both Catholic and Protestant) schools. Only 15 percent of private primary students in the country attend secular schools.

Data

This study uses data from the Madagascar Permanent Household Survey (*l'Enquête Permanente auprès des Ménages*), collected in 1993-94. The EPM is a comprehensive, multi-purpose nation-wide survey of 4,508 households that was supplemented by a community survey that includes information on local schools. Our analysis focuses on children of primary school age (6 to 12) excluding those (very few) who had already graduated primary school by age 12.

For each currently enrolled child the household survey records annual school expenditures on fees, books and uniforms, transportation, and other direct costs. The price variable used in the school choice models is the community (cluster) median of these per student expenditures for each primary school type (public or private). The costs to households of a child attending school also include opportunity costs, equal to the hours of market or home production foregone when the child attends school multiplied by the opportunity cost of time for the child. In rural Madagascar a large share of boys and girls of primary age engage in productive labor (see Glick 1999). However, because very few work for wages, obtaining an accurate measure of the value of time proved to be infeasible.[6] Therefore we include only direct school costs in the model. Including only one component of costs rather than the total cost in schooling or health care demand models is common in the literature, not surprisingly in view of data limitations that are typically encountered. However, a typically overlooked implication of this practice is that it will lead to omitted variable bias if the excluded costs are correlated with the included ones. We discuss this more formally in Appendix 2, where we suggest that to reduce the bias, one can parameterize the unobserved portion of costs as a function of observed household and community determinants. For the present sample we found that this approach did not materially change the price or other estimates.

School expenditures are substantially higher for private schools, reflecting much higher fees as well as higher expenses for other school items: the mean of community median annual expenditures for public primary school is 6,088 Malagasy Francs compared with 16,957 Fmg for private school (Table 1). The private cost per student is about 10% and 1.5%, respectively, of the sample medians of household per capita and total expenditures.

For the rural portion of the sample the household data are linked to community surveys conducted in the same *fokontany* (a village or clusters of small villages). A few communities (less than 10%) are nevertheless classified as 'urban' but for these cases 'semi-urban' would be a more accurate designation. For the school or schools (up to a maximum of three) used most frequently by households in the fokontany, information was collected on distance and transportation costs, numbers of students and teachers, simultaneous teaching of two or more

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[6] Fewer than 100 rural children between the ages of 6 and 12 reported working for a wage in our survey, and wage regressions on this sample yielded almost no significant coefficients. In principle, the implicit value of time of children could be obtained from production functions for family agriculture, but this is a complicated task with a number of practical difficulties. We are not aware of any schooling demand studies that attempt to get estimates of the cost of children's time in this way.

classes in the same classroom (multigrade teaching), and several indicators of facility condition. In about a third of the communities listing a public school and less frequently for private school, more than one school of a given type was recorded in the community survey. We used the characteristics of the closest school of the given type in the estimation, but the alternative of using averages for multiple provider cases yielded similar results.

As in other such surveys, the schools enumerated in the community survey do not always exhaust the universe of schools used by inhabitants of the community. We infer this from the household survey data, which show that in some rural communities children are attending a primary school type, usually private, that is not found in the community survey. This occurs when the missing school type is not widely used by local residents, as indicated by the fact that in these cases the number of children in the surveyed households in the cluster attending the school is usually very small (in half the cases, just one). In other cases we faced essentially the opposite problem: the school type, again usually private, was listed in the community questionnaire, but none of the sampled households in the community had children attending it. Hence we were not able to use the household survey data to construct a local price (community median school cost) for these schools. It was necessary to drop individuals living in communities that had partial information for either of these reasons.[7, 8] These and other adjustments lead to a sample reduction from 2,675 to 1,820 children age 6 to 12 residing in 120 Fokontany. The dropped communities are on average slightly wealthier, reflecting the positive association of access to private schools with household per capita expenditures. With such a sample reduction selection bias is potentially a problem. Our data do not allow us to deal with this concern using standard selection correction approaches, so we attempt to address the issue in other ways. We discuss these in section IV after presenting our estimates.

Table 1 shows non-enrollment and public and private primary enrollment rates for the sample of children age 6 to 12 by household per capita expenditure quintile. There are large differences by expenditure level in primary enrollment status. Fully 60 percent of the children in the poorest quintile do not attend school, compared with just 27 percent in the richest quintile. Private school enrollment is far less prevalent than public enrollment, but the private share rises sharply with expenditure quintile. Although this is consistent with private schooling being too expensive for poorer rural households, differences in availability may also be behind the lower private enrollments of the poor. As shown in the table, private school availability—defined as such a school being listed in the community survey—is generally low (23 percent on average) but rises with expenditure quintile. In our simulations below we investigate the importance of

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[7] An alternative approach to the second problem would be to impute prices from hedonic regressions estimated on the non-missing sample. However, the estimates of price effects in the provider choice model proved to be very sensitive to the specification of the hedonic regression. Because of this lack of robustness, we instead drop observations in communities with missing price data.

[8] A third possible situation, suggested by a referee, is that no children appear to attend private school *and* none is listed in the community data, but some children are sent to live away from home to go to a private school; hence private school is indeed, potentially, an option used by households in the community. We do not have information on schooling of children living away from home, but these types of children would be recorded in the rosters of the receiving households. These data show that private primary students are not very likely, and no more likely than public students, to be living away from home (defined as not being a child of the head of household in which they live): about 15% for both groups of students in the full (rural and urban) survey.

access by simulating the effects on private and overall primary enrollment of relaxing the constraint on private school availability.

Information on the characteristics of the nearest schools of each type is presented in Table 2. Multigrade instruction is widespread, occurring in two thirds of public schools and 56 percent of private schools. The practice is driven by a combination of low population density in rural areas and the government's long-standing commitment to maintain a primary school in almost all of the country's approximately 13,000 fokontany. As a consequence, many rural schools have relatively few students in each level. Since the supply of teachers is limited (and since providing a teacher for each grade would imply very high overall teacher to pupil ratios in many small schools) it is necessary that two or even three levels be combined per teacher. To the extent that multigrade and the other school indicators are proxies for quality, the figures imply that rural private primary schools are of higher quality than public schools. Strikingly, 40 percent of the nearest private schools have windows in "good" condition (none or few broken) compared with just 6 percent of public schools.

Additional descriptive statistics (not shown) indicate that in addition to having more access to private schools, better-off household have access to slightly higher quality local schools of both types. By and large, however, conditions in rural primary schools seems quite poor, especially in the public system. Building condition indicators are generally unfavorable, and the multigrade and student-teacher indicators point to a lack of teachers as a significant problem.

IV. Empirical Results

Nested logit results

Parameter estimates from the nested logit model of primary school choice are shown in Table 3. Reflecting the usual normalization, the estimates show the effect of the explanatory variables on the utility from a particular school alternative (public or private) relative to utility from the base option, non-enrollment. For the interactions of price and income with expenditure quintile, we combine the fourth and fifth quintiles. As noted earlier, there are relatively few observations from the highest expenditure quintile in our rural child sample. As per the discussion in section II, we estimate a flexible model that does not impose either cross-equation restrictions on the price effects or within equation equivalence of price and income effects. However, a likelihood ratio test could not reject the equality of the price coefficients for public and private school (p= 0.47) so the restriction is maintained in our estimation. With this restriction, we were also unable to reject the equality of the income coefficients for the two choices, so these parameters are also constrained to equality in the estimation. However, as already mentioned, likelihood ratio tests rejected the within equation restriction on the price and income coefficients. Therefore the model allows these parameters to differ.

The coefficients on price (annual direct schooling costs) are negative for each expenditure quintile and significant for all but the highest quintile level.[9] The price coefficients decline sharply in absolute value as the level of household expenditures rises, indicating that the poor are more sensitive to changes in school costs.

The estimates for school attributes indicate the importance of public school quality in parents' schooling decisions. In particular, the use of multigrade classes has a strongly significant negative impact on utility from public school. Although there is evidence from some developing countries that multigrade instruction need not be detrimental to learning if teachers are trained in the appropriate techniques (Little, 1995; Jarousse and Mingat, 1993), this specialized training does not occur in Madagascar. Therefore multigrade as currently practiced is thought to be a problem (see World Bank, 2002), something that our demand estimates bear out. 'Good' window condition, which may be acting as a proxy for overall facility quality, also has a significant (positive) impact for public school. These results are in line with the limited evidence from elsewhere in the region on the effects of school quality or school infrastructure on primary enrollment and academic achievement. Lavy (1992), for example, found for Ghana that the presence of leaking or unusable classrooms reduced primary enrollment probabilities. For Madagascar, Lassibille and Tan (2003) found that an index of school facility was positively associated with student test scores.

One standard 'quality' covariate, the student-teacher ratio, appears to have no influence on enrollment choices in our sample. This could be due to simultaneity—high local demand leading to a high number of students relative to staff, obscuring a true negative effect. However, the discussion of the impacts of student teacher ratios or class size in the U.S. context and elsewhere almost always assumes one teacher per class. Where this is often or even typically not the case, as in rural Madagascar, the overall complement of teaching staff per student may be far less important than whether teachers can teach one class at a time.

For private school, in contrast to public school, none of the school characteristics have significant effects on demand. This cannot be explained by a lack of variation in the data. Instead it may indicate that the marginal effects of school quality improvements on student achievement are greater when the level of quality is low (as it appears to be in public schools relative to private), or that the attributes in our data are substitutes in the production of human capital for other, unmeasured inputs (e.g., teacher quality) that are more lacking in public schools.

For public school we observe the expected negative effect of distance to the nearest school. There is no equivalent effect for private school, which may at first seem puzzling. However, since private schools are much less common in rural areas, they tend on average to be much further away than public schools, which are usually located within the fokontany. As a result, in many cases private schools are likely to be so distant as to simply not be considered as a relevant option in the community survey. Hence much of the effect of distance to private schools comes through 'availability', that is, through the inclusion or exclusion of a private

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[9] As in most previous studies, household consumption net of schooling is expressed in per capita terms, hence the price and expenditure price terms in the model are divided by household size.

option among the local school alternatives in the model. This again is a motivation for our simulations below of making private schools available to more communities.

Turning to individual and household covariates, gender has no impact on utility from either public or private primary school relative to non-enrollment, a result that is in line with the general equality between genders in enrollments in Madagascar, even at post-primary levels (see Glick et. al. 2000). As in virtually all other studies of education demand, parents' schooling—especially secondary attainment, which is rare in rural areas—raises the demand for both school alternatives. There is a negative association of enrollment and family size. Interpreted the usual way, which assumes that family size is exogenous to schooling choices, this result would be attributed to the fact that there are fewer resources per child, all things equal, in larger families. A greater number of adults raises the demand for either primary school type, possibly reflecting an association of this variable with household income.

It is difficult to assess the effect of household resources directly from the estimates because of the presence of the interaction terms and the general nonlinearity of the logit model. Therefore we calculated enrollment probabilities at different levels of household per capita expenditures controlling for other covariates (detailed results available from the authors). As in most studies for developing countries (Behrman and Knowles, 1999), we find that the level of household resources has strong effects on enrollment and school choice. For example, calculating the probabilities for the subsample with only public school available and controlling for other factors, the predicted primary enrollment probability for a child in a household with the mean expenditures of the top quintile (585,760 Fmg) is close to double (0.59 vs. 0.31) that for a child with mean expenditures of the bottom quintile (104,245 Fmg). [10] Further, we find that where private schooling is an option, it will account for the bulk of the increase in enrollments resulting from a rise in household expenditures.

Endogeneity and sample selection issues

Although our results for school characteristics are plausible, it is possible that the coefficients on the school attribute variables are picking up the effects of unobserved factors that affect both local school quality and the demand for schooling, i.e., the school covariates may be endogenous. School quality may be high in communities where parents have strong preferences for education and thus provide direct financial support or put political pressure on authorities to provide more school resources. Or, governments may direct quality improvements to communities where enrollment (hence demand) is low, a variant of the endogenous program placement problem described by Rosenzweig and Wolpin (1986). Either factor would imply that the errors in the individual utility functions incorporate a community level component that is correlated with school quality covariates.

Does this occur with our estimates, particularly with regard to the negative effect observed for multigrade classes? As described above, the need for multigrade is a function the

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[10]These estimates imply an income elasticity of enrollment of about .20, though it should be kept in mind that we are considering a far from marginal change in expenditures. This is large relative to the median of 0.07 found for all developing country studies in the survey of Behrman and Knowles (1999) but is consistent with their observation that the income elasticities are largest among the poorest countries.

number of students per level, the number of teachers, and possibly, the number of classrooms in the school. These factors are arguably exogenous in the rural Madagascar context. Especially in view of the policy of placing primary schools in even the smallest fokontany, the number of students per level will be driven in large part by variation across communities in the number of school age children, which determines the supply of students. Multigrade could be alleviated by adding teachers and classrooms to the school. However, it is doubtful that allocations of these school inputs in rural areas reflect responses to pressure on the part of local parents or officials (high demand), or, for that matter, to inadequate enrollment (low demand). Due to the highly centralized character of Madagascar's education administration, institutional mechanisms that would make this possible appear to have been lacking, at least prior to reforms instituted in the last several years.[11] With respect to direct contributions from the community, the school data indicate that parent associations often did provide some resources for maintenance and supplies to local public schools during the year preceding the survey, but it was not common for them to hire teachers (about 9% of fokontany) or to contribute to the cost of classroom construction (about 2% in the past year).[12]

It would be preferable nevertheless to be able to address the possibility of endogeneity more directly. A feasible approach with our data is to add to the model a number of additional community-level covariates that we would expect to correlate with unobserved local preferences for, or constraints on, schooling. Conditional on these controls, the correlation of the school attribute covariates and unobservables should be reduced, thus reducing any bias in the coefficients on the former. The second model shown in Table 3 adds the average education of household heads, median Fokontany household expenditures per capita, and an indicator of urban location. The introduction of these variables has only very minor impacts on the estimated effects of school characteristics. This applies also to the price-quintile terms. The only real exception is a reduction in the distance effect. Additional controls were tried, including infrastructure indicators and variables from the community survey recording the amount of annual financial support provided to the school by the community—which conditional on median or average community income and education should well capture heterogeneity in schooling preferences. The level of community support (and in other models, specific categories of contributions such as payments for teachers or room maintenance) turns out, not unexpectedly, to be significantly associated with public school enrollment probabilities. However, there were at most only modest impacts on the magnitudes and significance levels of school variables from adding these and the infrastructure covariates. The coefficient on the multigrade indicator rarely changed by more than 10%. To the best that we can determine with our data, then, the endogeneity of school characteristics does not seem to be a serious problem in our estimates.[13]

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[11] See World Bank (2003). The widely perceived lack of responsiveness to local education resource needs has been a major motivation for reforms undertaken since the date of the survey, in particular, a significant move toward decentralization from the central ministry to the country's 111 school districts.

[12] Selective migration, whereby households with strong schooling preferences move to where there are better schools, would similarly bias the estimates. Internal migration is quite low in Madagascar, however, as confirmed by the 1997 EPM survey which asked heads of households if the family had moved in the last year and why. Only 2.5% of married rural households heads age 25-45 had done so, with almost none of these listing children's education as a reason, suggesting that selective migration to areas of high school quality is not significant.

[13] One form of simultaneity which is *not* a concern is that caused simply by small cluster size such that an individual decision to enroll, by changing the number of students in the local school, directly influences the value of the

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Another potential source of bias raised earlier—and also related to unobservable community level heterogeneity—was sample selectivity through the exclusion of communities lacking school data. Using a Heckman-type correction is not feasible with our data, but to the extent that our community level controls capture unobserved differences in schooling demand between included and excluded communities, the problem can be interpreted as a "selection on observables" problem (Fitzgerald et. al., 1988).[14] The robustness of the estimates to the introduction of these terms suggests that selectivity bias is not operative. In addition, since most of the missing school and cost data problems concern private rather than public schools, we can examine the robustness of the *public* school estimates to sample reduction by re-estimating the model on (almost) all observations but specifying a different reduced form for conditional utility for private school, one that excludes the private school covariates. If the dropped communities are truly different in terms of unobservables from the included ones, we would expect selectivity to affect all the estimates, including those for utility from public school. The results (available from the authors) on the larger sample (n=2,412) are qualitatively very similar to the earlier results, with respect both to the sharply declining price effects by quintile and the relative magnitudes of the coefficients on the public school characteristics, and these estimates generally remain statistically significant at 5% (the coefficient on multigrade at 1%). The magnitudes are generally lower by some 30%, but because the logit estimates from the two samples are normalized on different variances of the conditional utilities, the strong qualitative similarity is of more relevance.[15]

These checks do not exhaust all possible sources of bias in our estimates. First, our data on school characteristics are somewhat limited. We do not have information, for example, on the availability of supplies and teacher qualifications. If these factors are positively correlated with included 'quality' covariates, the estimated impacts of the latter will be biased upward. On the other hand, measurement error in price and school characteristics, if present, will tend to bias these estimates toward zero. These potential problems, which are common in studies like ours, should be kept in mind when interpreting the estimates and the simulations to follow.

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multigrade indicator for the school. This can be a problem with the student teacher ratio, which is continuous. But the individual decision to go to school will have no influence on the discrete multigrade indicator except (and only with a lag) at the threshold point where the student population has reached a level such that the education authority decides to add or subtract a teacher (or construct a classroom), thereby leading to the separation or combining of levels.

[14] Barnow et. al. (1980) extended Heckman's sample selection correction model to deal with selection on observables by specifying the expectation of the outcome variable as a linear function of the structural regressors (school quality here) and the expectation of the error term conditional on the observables (the community covariates here). The second specification in Table 3 is a form of this model in which the conditional error expectation is approximated by a linear function of the community variables, along the lines suggested by Ziliak and Krecker (2001).

[15] The nested logit model normalizes the betas so that the ε_{ij} terms have the generalized extreme value variance (see Train 2003). This is relevant when comparing estimates from different samples since if the variances are different the normalization will differentially affect the magnitudes of the estimates in the two cases. However, it would leave the internal patterns among coefficients unchanged.

Price elasticities

Table 4 presents price elasticities for public and private schooling by expenditure quintile, calculated from the parameter estimates and the data. Since the responses to price changes will depend on the availability of alternatives, we calculate the elasticities both for the full sample (for which a public school but not necessarily a private school is available) and for the subsample of observations in communities with both a public and private school option. Column 1 shows for the full sample the quintile means of the own price elasticity of public schooling. Overall, the demand for public primary school appears to be inelastic—the mean elasticity for the sample is -0.18 (it should be kept in mind that this is the elasticity with respect just to direct, not total, school cost). However, there are large differences by quintile in the elasticities, in line with the pattern observed in the parameter estimates. The public school own price elasticity declines from -0.26 and -0.28 for the poorest two quintiles to -.08 and -.11 for the wealthiest two quintiles. Recall from section II that if the quintile-specific elasticity is greater than (less than) the population elasticity, a price increase will reduce (increase) the quintile's share of the total benefits. From the table it can be seen that the public school (and overall primary) price elasticities for the bottom two quintiles are each larger than the sample mean elasticity while for higher quintiles the elasticities are below the mean. Therefore the poorest two quintiles' shares in total public (and all) enrollments will fall from a fee increase while the shares of higher quintiles will rise. In this sense, such an increase would indeed be regressive.

The cross price effects on private school enrollment appear to be very small (column 2), but this largely reflects the fact that for the majority of observations in the full sample private schools are not available. For the subsample with a private option, both the cross elasticities and own elasticities are substantially larger (columns 4 and 5). Because of substitution between public and private providers, a modest proportional cost increase in public schools in communities where private schools are also available would lead to fairly significant reductions in demand for public schooling (confounding any revenue-generating aim of the price increase) while having very little effect on overall enrollment rates, as the last column shows.

Policy simulations

Tables 5 through 7 report the results of the simulations. Table 5 indicates the overall sample mean changes in predicted public, private, and overall primary enrollment probabilities (equivalently, predicted enrollment rates) for different policy scenarios. For each policy we also calculate the cost to the government using unit cost data (for teachers, teacher training, room construction, and supplies) provided by the education ministry.[16] These calculations also take into account the increase or decrease in fee revenues coming through changes in predicted student numbers and in fee levels themselves if applicable. The 5th column of Table 5 shows the aggregate costs of implementing the policy in the sample communities. In addition, in the last two columns of the table we provide a sense in proportional terms of the resources that would be

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[16] We are grateful to Mr. Arsene Ravelo and colleagues at MENRS (Ministère de l'Education Nationale et de la Recherche Scientifique) for providing these cost estimates.

needed at the national level by comparing the recurrent and total cost of implementation to current levels of government spending on primary schooling in these communities. The latter are estimated from ministry data on primary school spending per student (reported in World Bank, 2002).

The first policy we consider is a quality improvement in the public schools: a reduction in multigrade teaching through the provision of additional teachers. The school data indicate only the presence of multigrade, not its extent (number or share of classes that are combined), which is necessary to know in order to cost a policy of reducing multigrade. However, we are able to use data from a small nation-wide school survey conducted in 2002 to impute the number of teachers and total sections (levels) offered, hence the extent of multigrade in the schools in our sample. The median imputed values for rural public schools are approximately 4 sections (levels) and 2 teachers on staff; hence in the typical school each teacher instructs 2 classes simultaneously, and each class is combined with one other.[17] To eliminate multigrade would thus require on average a doubling of the number of teachers from 2 to 4 per school. Given the extent of the practice in rural areas, complete elimination of multigrade is not feasible and we instead evaluate a policy to cut it in half by adding an average of one teacher to each school currently using multigrade instruction.[18] Further, for many schools, it is likely that a lack of classrooms is an additional constraint on their ability to offer separate classes. Therefore we also calculate the costs assuming that that a new classroom must be added to each of the schools. This would represent an upper boundary on the costs of the policy.

For the sample of communities practicing multigrade in local public schools, the effects of hiring an additional teacher/cutting multigrade by 50%, shown in the first line of column 1, are not trivial, especially considering that on average this would eliminate the practice in only half of the sections offered by these schools. Mean public enrollment rises 6 percent, from .42 to .48. With modest substitution from the private sector, overall primary enrollment rises 5 percentage points, a 10% improvement in proportional terms. There are also presumed gains to student learning from having more classes taught separately, so the benefits from this policy would go beyond these increases in enrollments.

The budgetary impacts are significant though not extraordinarily large. The aggregate cost of hiring the new teachers (which assumes the need to train them as well) represents about a 10% proportional increase in the estimated total annual spending on these primary schools (col. 7). If the affected schools had to construct a new room to accommodate each additional

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[17] The 2002 project Ilo survey (Lalaina and Minten, 2003) collected detailed information on 376 schools nationwide. Parameter estimates from regression of the level of multigrade (number of classes combined) on number of students, teachers, and province controls using this sample were employed to impute the multigrade index for the schools in our survey. The imputed medians reported in the text for our sample are very similar to the actual means or medians from the 2002 survey, suggesting the two samples are comparable. Further, our imputations (for number of sections offered, number of teachers, and number of combined sections per school) are close to the means of these variables derived from the nationwide school data in the education ministry database.
[18] In doing so we assume in the simulation that the effect of this on utility from public school is half the effect given by the coefficient on multigrade. This is sensible if we assume there is a linear underlying impact on utility of the (continuous) degree of multigrade. Then the coefficient on the dummy indicator approximately measures the effect of having multigrade at the weighted sample mean value of this index relative to when it is zero; hence halving the index as described in the text will change utility by half the estimated effect.

teacher the annualized overall cost would be much higher, as shown the table. The cost of the policy would then represent close to a 20% increase over existing levels of public expenditures.

In distributional terms the outcomes of such a policy would be favorable. The first three columns of Table 6 show for overall primary schooling the quintile-specific initial predicted enrollment rates, the predicted enrollment rates after the multigrade reduction, and the changes in the enrollment rate. The figures in parentheses correspond to the benefit distribution measures discussed in section II: they show the quintile shares in aggregate enrollments (or, in the 3rd column, the marginal shares) divided by the quintile shares of the rural primary school-age population. The 3rd column indicates that the percentage increases in primary enrollment rates are larger for children in the bottom three quintiles than for the top two quintiles. One factor contributing to this outcome is that poor households live in areas where school characteristics, including the use of multigrade, are less favorable, so on balance they benefit most from the improvement. Comparison of the relative marginal shares highlights these differences. For example, the ratio is 1.13 for both the 2nd and 3rd quintiles, meaning that the share of the increase in enrollments accounted for by children in these quintiles is 13 percent larger than their shares of the rural primary age population. In contrast, the share of new enrollments for the highest quintile is less than 70 percent of their child population share.

The other distribution measure we consider corresponds to (a change in) the more typical measure used in benefit incidence: the average benefit shares, indicated by the figures in parentheses in the first two columns. The average enrollment shares of the bottom three quintiles each gain slightly at the expense of the top two, meaning that the distribution of schooling has become more progressive. This is true for public primary as well as all schooling.[19]

The next simulations explore the implications of combining the same policy of hiring of one new teacher per school with cost-recovery. Table 7 shows enrollment outcomes for a range of possible across the board increases in public school fees. As expected, raising fees progressively offsets the gains in enrollments from hiring more teachers. A fee increase of 5000 Fmg (about $2.50) yields mean enrollments that are about the same as before the policy, though presumably with gains in school quality. This sum represents a large increase over existing fee levels and is roughly equivalent to a doubling of total household direct public schooling costs per child. If the fees are imposed both in communities receiving the new teachers and those not, the new revenues would cover a non-trivial portion—about a third—of the additional costs (bottom row). However, there would be strongly negative implications for equity, because of the higher price elasticities of poorer households. Enrollments of the poorest quintiles actually fall relative to before the policy while the top quintile gains. Even smaller fee increases would reverse the moderately progressive nature of the multigrade reduction, as shown in Table 6 for an increase of 2000 Fmg. The shares of new enrollments going to the bottom two quintiles are just .38 and .46 of their school age population shares and their average benefit shares relative to population fall slightly. To avoid these negative equity outcomes, the fee policy would have to be set up so

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[19] Note, however, that the average share of enrollments rises for the poorest quintile even though children in this quintile receive a less than proportionate share of the incremental enrollments (the marginal share ratio in column 3 is less than unity). This underscores our comment in Section II that it is important to distinguish between the distribution of the marginal benefits and the change in the distribution of average benefits.

that richer households (or communities) pay higher fees and thus cross-subsidize improvements in poorer ones, something that may be difficult to implement for political reasons.[20]

Multigrade and related problems of inadequate staffing and low quality derive in large part from the need to stretch resources to accommodate the presence of a school in almost all of Madagascar's rural fokontany. It has been suggested, therefore, that there may be benefits to school consolidation: closing some small schools while improving the quality of others (World Bank, 2002). Our next simulation considers a policy of closing half of all rural schools currently operating with multigrade and transferring the teachers to the primary school located in a neighboring fokontany which also has a multigrade school. This is done by randomly selecting half the multigrade communities to receive the additional teachers in the local public primary school; on average this just eliminates multigrade in these schools because the number of teachers would double from 2 to 4 (recall the discussion above). Households in the remaining half of the initially multigrade communities also can now attend schools with separate classes— but now the nearest public primary school is located in the next fokontany. Given the negative impact of public school distance in the school choice model, much will depend on our assumptions about how far away this would be. In our community survey, the median reported distance to the nearest primary school for those communities lacking their own school is 2 km and we use this as a lower bound of the distance in the simulations (lower on the assumption that where a fokontany is not assigned its own school it is because the nearest center with a school is relatively close). We then experimented with assumptions of greater distances.

Note first from Table 5 (cols. 5 and 7) that the overall costs to the government of this policy are relatively low, because teachers are not hired or trained, merely transferred from one school to another. The only significant costs are for constructing additional classrooms in the consolidated schools. However, the enrollment gains are very modest, even for a distance of only 2 km between fokontany: a 2% increase for the sample overall, equivalent to a 4% proportional gain. For 3 km there are essentially no gains. For greater distances—which are certainly plausible—the overall impact on enrollments becomes negative. Given the negative impact of distance on schooling demand, therefore, school consolidation with multigrade reduction (and likely, other quality improvements as well) does not appear to be a realistic option in rural areas except where schools/communities are particularly close to one another.

Finally, we consider an expansion of private schools. Given how small many rural public schools already are, it is unrealistic to expect that the private education sector, even if heavily subsidized, would be able to operate in every village.[21] We assume more plausibly that private schools are opened in half of the communities not currently served by them. The choice probabilities for individuals in these communities are recalculated assuming that a private school with the mean attributes and cost of existing private schools is among the available school

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[20] In fact, as indicated, the simulations already assume some degree of cross subsidization because the fee increase is across the board, including in communities which have no multigrade hence experience no improvement. As noted, these communities tend to be wealthier.

[21] Unless perhaps they actually replaced existing public schools. Having this be the outcome of public subsidies to the private sector would raise a number of political and equity issues so does not seem to be feasible.

options.[22] The new schools will operate only in every other community lacking a private school, but households in neighboring fokontany will have access at some positive distance, and as before we simulate the policy under a range of assumptions about the proximity of neighboring fokontany to each other. In view of the doubts raised in section IV about the reliability of the logit estimate for the effect of distance on private school utility, we assume instead that the distance effect is the same as that estimated for public school. If the inclusion of the school attributes and other covariates effectively purge the association of distance with unmeasured school quality, then the public school distance estimate represents the 'pure' distance effect and would be applicable to private school utility as well.

Making private providers available would lead to a substantial reallocation from public to private schools (Table 5, cols. 1 and 2). However, the sample-wide effects on overall (private and public) primary enrollment are modest and similar to that obtained from a 50% multigrade reduction – a 3 percentage point increase for a distance of 3 km between communities. What is quite different are the distributional outcomes, shown in Table 6 (3rd simulation). Because well-off households are more likely to take advantage of the new, more expensive, private options, the gains in both private and overall primary enrollment are larger for wealthier households within the communities affected (compare lower vs. upper quintiles' changes in enrollment and marginal share ratios). This overwhelms the tendency for these communities, i.e., those currently lacking private schools, to be poorer overall. The reductions in the poorest two quintiles' average benefit share ratios indicate that disparities in overall primary enrollment between poorest and wealthiest households increase slightly from the expansion. On the other hand, because public enrollments fall proportionately more for higher income households, the share of the poor in *public* primary enrollments rises (not shown in the table). Precisely this outcome is often cited in support of the growth of the private education sector—it makes public education spending better targeted to the poor (see Hammer et. al., 1995)—though this may seem less attractive if it also makes the distribution of overall primary schooling less equal.[23]

The negative distributional outcomes could be reduced or avoided, and overall gains in enrollment would be larger, if the subsidy also insured (as through a voucher system) that households could pay less than the current mean costs of private primary schools. If the fees charged at the new private schools were set at half the mean fee of existing private schools, overall enrollments would rise 5 percentage points, a 9% proportional gain (Table 5, last simulation). The poorest quintiles' shares of the new enrollments are still well under their shares of the school age population, but less so than before (Table 6, last column).

Since the private sector does not currently choose to operate in these areas, we would expect some level of public contribution to be required for the new private schools to be viable.

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[22] The procedure is similar to the practice in the consumer demand literature of using estimates of discrete choice models to predict the demand for a new product. An application close in spirit to the present one is Lavy and Quigley (1993), who predict the effect of expansion of health care provider options in Ghana.

[23] In urban areas, private schools should be relatively accessible in terms of location to most urban households. Hence it is noteworthy that the EPM data for urban areas indicates that private primary enrollments, while generally higher, show the same pattern by quintile as in rural areas: the share of private in total primary enrollment in urban locations is just 0.18 for the first quintile compared with 0.65 for the highest quintile. This supports the implication of our simulation that the rural poor will be significantly less likely than the well-off to take advantage of private schools even if the constraint on availability was relaxed.

A plausible means by which the government could support a private expansion would be to subsidize the costs of construction of new schools, after which private operators would be expected to cover recurrent costs. Direct information on private school costs is lacking so we assume that unit values for facilities, teachers, and supplies are the same as for public schools.[24] The number of teachers hired in each new school was imputed by first regressing the numbers of teachers on the numbers of students in the sample of existing private schools, then using these estimates to predict the teachers required for new schools (median=46) based on the simulated numbers of students.[25] The average number of predicted teachers per school is just under 2. We assume a minimum of two teachers per school and that one classroom per teacher must be constructed. These capital costs to the government are shown in Table 5, col. 5. For roughly similar mean enrollment impacts, they are less than the total public costs of the multigrade reduction policy considered above if the latter includes both teacher and classroom construction costs.

But would private operators be able to cover the costs of running the new schools? Note first that the new schools tend to have fewer students than existing private schools (for which the median is 120 students), suggesting that the level of local demand, while not trivial, would be inadequate. More concretely, in the first expansion scenario above, the revenues from students, including both fees and expenses for books, uniforms, etc.(which are assumed to be paid to the schools to offset the cost of supplies), amounts to about 550,000 Fmg for a school with the median number of new students while the recurrent cost of teachers and supplies for such a school would be about 4,800,000 Fmg. These schools thus would be far from being able to cover costs. For the simulation with private fees equal to half the current private school mean, the deficit would be larger but not very much so, since the lower revenue per student is offset by having more students. Based on the approximate but reasonable unit cost values we are using, it almost certainly the case that most existing private primary schools, despite being larger, similarly do not cover their operating costs just from revenues from parents.[26] As noted, the majority of such schools in rural areas are church-run rather than for-profit enterprises. Our numbers suggest, plausibly, that these schools are sustained by subsidies from the churches or the community. It is far from clear that parishes or communities that do not already support a private school would have the resources to do so even if the government subsidized school construction. Further, due to a lack of significant economies of scale, it is likely that, even if a school construction program were combined with a voucher program for households that covered the full value of fees and other typical private school expenses and thus raised demand significantly, the new private schools would still require substantial additional support.

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[24] This assumption seems reasonable. First, building construction costs should not differ for private and public schools. Second, the great bulk of recurrent costs will be teacher salaries, and evidence indicates that pay for public sector teachers is comparable to private sector wages (including presumably for teachers) for equivalent educational attainment (reported in World Bank 2002 Table 3.1)

[25] The numbers of new private students are based on the simulation using a distance of 3km between fokontany, from which we obtain the predicted private enrollment rate. To get the total number of private enrollees we multiply this rate by the local school age population; the latter is calculated by multiplying the number of current public school students by the current public enrollment rates in these communities.

[26] Calculated at the median values for teachers and students in existing private schools, the operating deficit is smaller per student but larger overall relative to the figures discussed for the new schools. The scope for economies of scale for individual private schools is limited because the number of teachers eventually must increase as the number of students rises.

V. Summary and Discussion

The demand for primary schooling and the choice between public and private schools in rural Madagascar is responsive to changes in household resources, school costs and school quality. These results help put in perspective the sharp declines in primary enrollments experienced by Madagascar beginning in the 1980s. These declines have been attributed alternately to falling incomes and a deterioration in the quality of the public school system over the period. Both trends emerge as plausible factors in light of our econometric estimates.

The model estimates indicate that the poor's demand for public and overall primary schooling is substantially more price-elastic than that of the wealthy. Prices increases for public schooling therefore have negative implications for equity: they will make the incidence of public primary school benefits less progressive and will increase disparities in total (public and private) enrollments between the poor and the wealthy. Simulations indicate that cost-recovery strategies can have these adverse distributional consequences even when they are used to finance school quality improvements that disproportionately benefit poorer communities.

Our policy simulations also indicate that improvements in rural public school quality, in particular adding teachers (and classrooms) to reduce the need to combine multiple grade levels in the same class, will have positive and equity-improving effects on public school enrollment. Reducing by half the number of classes taught as multigrade would lead to modest improvements in overall rural primary enrollments at a cost of between 10 and 20 percent of existing public expenditures on primary schooling in rural areas. An alternative policy of school consolidation would impinge less on the public sector budget while permitting more extensive quality improvement (multigrade reduction) in the schools that remain open. But it will likely have little benefit in terms of enrollment rates, and may even reduce enrollments, because of the negative impact of distance to school.

Our simulations show as well that households will respond to the presence of private school options, which are currently not available to most rural communities.   However, in contrast to public school improvements, a private school expansion will worsen rather than improve overall education equity unless fees in new private schools are considerably below levels currently charged by the private sector.   On the financing side, the results indicate that there are limits to what the government can reasonably expect to achieve with a strategy that seeks to increase primary enrollment and education quality by subsidizing private school development. Even if the public sector absorbed the costs of private school construction and issued vouchers to parents for tuition and other expenses, revenues would be far from sufficient to make the schools viable. Future expansion of the private sector in primary education will probably be gradual and depend, as past growth seems to have done, on significant support from churches or other non-governmental institutions.   Still, in view of the research suggesting that quality is higher in private schools, there may be benefits, even if modest ones, to policies to promote the private sector in education.

With regard to multigrade teaching and other aspects of education quality, Madagascar, like other African countries with low population density and resource shortfalls, faces a tradeoff

between quality and access. Insuring the presence of easily accessible schools to all rural residents makes the need for multigrade teaching inevitable and in general implies inadequate levels of resources per school; school consolidation can make possible quality improvements but will also make school inaccessible for many children.   Our analysis indicates that providing more teachers to rural schools can raise enrollments by reducing the need for multigrade instruction. The costs, while not beyond reach, are significant for fairly modest enrollment gains. Other interventions, which we are not able to evaluate with our data but which have been applied with success elsewhere in the developing world, may well be more cost-effective. One is to rigorously train teachers in the appropriate pedagogy for multigrade situations. Another is to institute biennial intake of children into first grade to cut in half the number of levels that must be taught each year.

Appendix 1: Conditional utilities with income-proxied tastes for different alternatives

Assume a simple linear version of equation (3) in the text and add to it a parental "taste" variable T_{ij} that is unobserved by the researcher:

$$(A1.1) \qquad V_{ij} = \gamma Q_j + \delta_j X_i + a_1(Y_i - P_j) + dT_{ij} + \varepsilon_{ij}$$

T_{ij} represents preferences for different schooling alternatives, hence is indexed on j. Assume that these tastes are associated with income through by the simple parameterization $T_{ij} = \lambda_j Y_i + \omega_{ij}$. Substituting in (A1.1):

$$(A1.2) \qquad \begin{aligned} V_{ij} &= \gamma Q_j + \delta_j X_i + a_1(Y_i - P_j) + d\lambda_j Y_i + \{d\omega_{ij} + \varepsilon_{ij}^*\} \\ &= \gamma Q_j + \delta_j X_i + b_j Y_i - a_1 P_j + \varepsilon_{ij}' \end{aligned}$$

where $b_j = a_1 + d\lambda_j$. In contrast to the standard model, the coefficient on Y_i differs from the price coefficient in this model and is indexed on j. Hence we have the following general function:

$$(A1.3) \quad V_{ij} = \gamma Q_j + \delta_j X_i + \alpha_{1j} Y_i + \alpha_2 P_j + \varepsilon_{ij}'$$

in which a_1 is identified from the price parameter (it is equal to $-\alpha_2$). If we apply this reasoning to our model with consumption-quintile interactions we have:

$$(A1.4) \quad V_{ij} = \gamma Q_j + \delta_j X_i + \Sigma_k \alpha_{1kj} Y_i E_k + \Sigma_k \alpha_{2k} P_j E_k + \varepsilon_{ij}'$$

If rather than this equation, the appropriate model is given by our initial formulation of text equation (3), the terms containing Y_i do not enter the likelihood function because they difference out of the decision rule (using eq. 3 and applying the decision rule that j is chosen if $V_{ij} > V_{ik}$, all $j \neq k$, yields $\gamma(Q_j - Q_k) + (\delta_j - \delta_{jk})X_i + a_{11} E_1(Y_i - Y_i) \ .. + a_{1K} E_K(Y_i - Y_i) + a_{11} E_1(P_j - P_k) \ .. + a_{1K} E_K (P_j - P_k) > \varepsilon_{ik} - \varepsilon_{ij}$; the terms containing Y_i drop out). Hence estimation using text equation (3) is equivalent to specifying conditional utility simply as

$$(A1.5) \quad V_{ij} = \gamma Q_j + \delta_j X_i - \Sigma_k a_{1k} P_j E_k + \varepsilon_{ij}'$$

This is the same as text eq. (4) without the income terms $Y_i E_k$ (given $\alpha_{2k} = -a_{1k}$). Hence there is a simple test of the relevance of omitted taste factors in schooling choices, and by extension, of our specification of separate income and price effects: the assumption (implicit in the standard model) that income-proxied preferences are not related to utility from different alternatives imposes a zero restriction on the choice-indexed income*quintile coefficients. We examined this restriction for all variants of the school choice model, and in all cases likelihood ratio tests rejected the null that the α_{1kj} were jointly equal to zero at the 5 percent level or better. Hence (A1.4), including the income terms to control for omitted tastes, is preferred.

Appendix 2: Estimating the school choice model with incomplete cost information.

As noted in the text, data limitations often make it necessary to include only one component of costs to represent all costs of using a provider. To consider the implications of this for the estimates of price effects, we work with a simple linear version of equation (3) in the text. Define P_j^m as the measured component of cost and P_{ij}^u as all other school costs, the unobserved costs. In our case P_j^m refers to direct school expenses while P_{ij}^u refers to indirect (opportunity) costs. Total cost $P_{ij} = P_j^m + P_{ij}^u$ and household consumption net of schooling is thus $Y_i - P_j^m - P_{ij}^u$. Substituting in (3):

$$(A2.1) \qquad V_{ij} = \gamma Q_j + \delta_j X_i + a_1(Y_i - P_j^m - P_{ij}^u) + \varepsilon_{ij}$$

This is the 'true' model. The actual net consumption variable used is just $Y_i - P_j^m$, however. This sets up the possibility of a bias in the estimate of a_1, which we can interpret as a form of omitted variable bias. It occurs if the unobserved costs correlate with the included net consumption variable, or more specifically, with either of its elements Y_i or P_j^m. [27]

To deal with the problem of missing indirect schooling costs, we can treat this part of cost as an unobserved variable that can be parameterized as a function of measured individual, household, community and school factors. This is akin to the way unobserved schooling outcomes or human capital improvements are treated in these models. Many of the relevant factors, such as age and sex, already appear in the model as demand shifters X_i. We assume for simplicity that all X_i are also contained in the vector of determinants of P_{ij}^u while a set of other household or community determinants of P_{ij}^u, designated by Z_i, are not in X_i. Including as well school-related factors that affect unobserved costs and assuming linearity we have:

$$(A.2.2) \quad P_{ij}^u = c_1 X + c_2 Z_i + c_{3j} Q_j + v_{ij} + u_j$$

Z_i might include agricultural and other productive assets, and community characteristics that affect farm or enterprise profits. Through their effects on the marginal return to the labor of the child, these factors influence the opportunity cost of schooling. School factors Q_j may affect opportunity costs through differences in distance and travel times and in the time a child is expected to devote to study outside of school hours. The error terms v_{ij} and u_j capture the influences on indirect costs of unobserved individual/household/community factors and school factors, respectively. Substituting (A.2.2) into (A.2.1) and rearranging yields:

$$(A.2.3) \qquad V_{ij} = \gamma^* Q_j + \delta_j^* X_i + \xi_i Z_i + a_1(Y_i - P_j^m) + \varepsilon_{ij}^*$$

where

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[27] Since the income term Yi drops out of the estimation in this linear model, one would be correct in arguing that only if Piju (not Piju or Yi) is correlated with the included price term Pjm is there a bias in a1. However, while this is true for the linear specification, most researchers include interaction terms such as YiPjm to insure that income does play a role in the choice among school alternatives. The coefficient on the interaction captures non-linearities in the price effect and since the interaction includes Yi, it will be biased if there are omitted cost factors that are correlated with income.

$$\gamma^* = (\gamma - a_1 c_{3j})$$

$$\delta_j^* = (\delta_j - a_1 c_1)$$

$$\xi_i = -a_1 c_2$$

$$\varepsilon_{ij}^* = \{\varepsilon_{ij} - a_1(v_{ij} + u_j)\}$$

Estimation of (A.2.3) will yield unbiased estimates of the price effects if, conditional on Z_i as well as X_i and Q_j, the disturbance term $(v_{ij} + u_j)$ is independent of net income. The bias will not be completely eliminated if there exist determinants of P_{ij}^u that are excluded from Z_i and are also correlated with the elements of net income.

In practical terms, the model differs from the basic specification by the inclusion of covariates Z_i that influence unobserved indirect costs. Some of these variables might not be among those typically entered in a schooling demand equation; however, the foregoing discussion implies that this expanded vector of right hand side variables corresponds to the correct reduced form model when opportunity costs are not directly measured. In our estimations we included covariates such as the value of agricultural assets, detailed household composition variables, and dummies for location (province), as each of these may affect either the demand for or the productivity of a child's labor, hence the opportunity costs of attending school. We also add a number of indicators of community infrastructure such as presence of a road or a local market, which also may affect the returns to child labor. Note from (A.2.3) that the coefficients on variables such as age and sex that are in both X_i and Z_i capture both direct influences on demand and indirect impacts through their effects on unobserved school costs.

As reported in the text, for our sample the inclusion of the additional regressors by and large had little impact on the estimates of interest. However, province dummies, which broadly capture the determinants of unobserved costs, proved to be important controls. Many other factors affecting opportunity costs are presumably already captured through the standard covariates X_i. Another explanation, of course, is that in this context the excluded schooling costs are largely uncorrelated with the included ones, so there is little problem of bias to begin with.

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Table 1: Enrollment status and school availability indicators by household by per capita household expenditure quintile

	Expenditure quintile					All
	1	2	3	4	5	
Not enrolled	0.6	0.48	0.49	0.4	0.27	0.48
Enrolled in public primary school	0.34	0.49	0.46	0.49	0.51	0.44
Enrolled in private primary school	0.06	0.04	0.06	0.12	0.22	0.08
School availability indicators:[a]						
Public primary	0.96	0.96	1	0.98	0.96	0.97
Private primary	0.21	0.21	0.16	0.31	0.38	0.23

Notes:

For the sample of children age 6-12 used in the primary school choice estimations (n=1820).

[a] =1 if the school type is listed in the community survey as one of the three schools most frequently used by residents of the community.

Table 2: Descriptive statistics

	Mean	Standard deviation
Individual/household characteristics		
Annual household expenditures per capita (Fmg)	222,196	148,951
Female	0.51	0.50
No. of children	4.06	1.72
No. of adults	3.10	1.57
Mother no education		
Mother primary education	0.44	0.50
Mother Secondary or higher	0.08	0.27
Mother education missing	0.01	0.10
Father no education		
Father primary education	0.51	0.50
Father secondary or higher	0.12	0.33
Father education missing	0.03	0.17
Public school characteristics [a]		
Annual costs (Fmg)[c]	6,088	4,325
Distance (km)	0.28	1.39
Student-teacher ratio	55.75	45.73
Maximum class size	45.19	23.61
Multigrade instruction[d]	0.67	0.47
Building condition[e]	0.40	0.49
Window condition[f]	0.06	0.24
Roof condition[g]	0.27	0.44
Private school characteristics [b]		
Annual costs (Fmg)[c]	16,957	13,222
Distance (km)	0.29	0.61
Student-teacher ratio	44.67	15.26
Maximum class size	48.02	58.92
Multigrade instruction[d]	0.56	0.50
Building condition[e]	0.87	0.34
Window condition[f]	0.40	0.49
Roof condition[g]	0.56	0.50

Notes:

[a] Data on closest public school for sample with public school available (n = 1784)

[b] Data on closest private school for sample with private school available (n = 504)

[c] Community median annual expenditures per student US $1.00 = 1914 Fmg

[d] =1 if two or more levels are taught simultaneously, zero otherwise.

[e] =1 for good or fair building condition, zero for bad building condition.

[f] =1 for none or few windows missing/broken, zero for many missing/broken or no windows.

[g] =1 for good or fair roof condition, zero for bad roof condition.

Table 3: Primary School Choice Nested Logit Model Estimates

					Including community variables			
	Public school		Private school		Public school		Private school	
Variable	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
School variables:								
Price (α_{2k}) :								
Quintile 1	-0.060	-2.871 ***	-0.060	-2.871 ***	-0.058	-2.900 ***	-0.058	-2.900 ***
Quintile 2	-0.056	-3.437 ***	-0.056	-3.437 ***	-0.060	-3.721 ***	-0.060	-3.721 ***
Quintile 3	-0.025	-2.133 **	-0.025	-2.133 **	-0.025	-2.127 **	-0.025	-2.127 **
Quintile 4-5	-0.008	-1.445	-0.008	-1.445	-0.012	-2.025 **	-0.012	-2.025 **
Distance (km)	-0.532	-2.945 ***	0.296	1.101	-0.375	-2.521 **	0.464	1.670 *
Multigrade classes	-0.584	-3.221 ***	0.321	1.088	-0.584	-3.087 ***	0.396	1.395
Window condition	0.568	2.019 **	0.069	0.219	0.598	2.128 **	0.054	0.152
Building condition	0.183	1.304	-0.119	-0.277	0.138	0.996	-0.708	-1.477
Pupil-teacher ratio	0.001	0.358	-0.004	-0.413	0.001	0.721	0.006	0.645
Pupil/teacher data missing[a]	-0.401	-1.428			-0.291	-1.005		
Household/individual variables:								
Constant	-3.083	-3.328 ***	-3.101	-2.585 **	-1.574	-1.672 *	-3.911	-2.124 **
Expenditure per capita/100 (α_{1k}):								
Quintile 1	0.016	0.560	0.016	0.560	0.024	0.813	0.024	0.813
Quintile 2	0.044	2.111 **	0.044	2.111 **	0.050	2.320 **	0.050	2.320 **
Quintile 3	0.022	1.430	0.022	1.430	0.024	1.535	0.024	1.535
Quintile 4-5	0.017	1.996 **	0.017	1.996 **	0.024	2.334 **	0.024	2.334 **
Female	0.100	0.878	-0.049	-0.197	0.068	0.592	-0.034	-0.144
Age	0.254	3.741 ***	0.240	3.330 ***	0.252	3.614 ***	0.222	3.083 ***
No. of children	-0.039	-0.997	-0.268	-2.956 ***	-0.052	-1.277	-0.257	-2.952 ***
No. of adults	0.116	2.079 **	0.291	3.342 ***	0.120	2.054 **	0.270	3.227 ***
Mother primary	0.540	2.813 ***	0.310	0.876	0.442	2.474 **	0.123	0.367
Mother Secondary or higher	1.251	2.861 ***	1.396	2.267 **	1.078	2.595 ***	1.005	1.753 *
Mother education missing	-0.287	-0.485			-0.003	-0.005		
Father primary	0.506	2.666 ***	1.349	2.896 ***	0.254	1.559	1.077	2.624 ***
Father Secondary or higher	1.639	3.516 ***	2.880	4.148 ***	1.311	3.110 ***	2.518	4.014 ***
Father education missing	0.226	0.639	0.926	1.098	0.011	0.030	0.597	0.763
Community variables:								
Rural					-0.820	-2.416 **	-0.138	-0.205
Median household expenditures per capita					-0.030	-2.377 **	0.011	0.513
Mean household head schooling					0.296	3.242 ***	0.303	2.095 **
Sigma	0.941	4.096 ***	0.941	4.096 ***	0.842	3.905 ***	0.842	3.905 ***

No. of observations = 1820

Notes: Base choice is non-enrollment. For mother and father education, the excluded category is no schooling. The model also includes controls for province.

[a] equals 1 if either the number of teachers or number of students is missing from school data.

* significant at 10%; ** significant at 5%; *** significant at 1%

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Table 4: Price elasticities by expenditure quintile

	Public school price elasticities						Private school price elasticities		
	Public available sample (n=1784)			Public and private available sample (n=504)			Public and private available sample (n=504)		
Quintile	Own price elasticity[a]	Cross price elasticity[b]	Net elasticity[c]	Own price elasticity[a]	Cross price elasticity[b]	Net elasticity[c]	Own price elasticity[d]	Cross price elasticity[e]	Net elasticity[f]
1	-0.26	0.05	-0.22	-0.38	0.26	-0.15	-0.87	0.19	-0.10
2	-0.28	0.06	-0.24	-0.46	0.33	-0.22	-1.29	0.27	-0.12
3	-0.13	0.03	-0.11	-0.21	0.17	-0.06	-0.59	0.16	-0.04
4	-0.08	0.03	-0.06	-0.13	0.10	-0.03	-0.37	0.23	-0.03
5	-0.11	0.06	-0.06	-0.16	0.17	-0.02	-0.51	0.39	-0.02
All	-0.20	0.04	-0.16	-0.27	0.21	-0.10	-0.70	0.25	-0.06

Notes:

Computed from nested logit parameter estimates and data using analytical derivatives. Elasticities are computed for each observation; table shows overall sample and quintile means. In this and subsequent tables, the "all" row gives the average taken over the full subsample being considered. This differs from the mean of the quintile-specific averages because there are more children in lower quintiles, which thus have larger weights.

[a]elasticity of public school probability with respect to public school price

[b]elasticity of private school probability with respect to public school price

[c]elasticity of probability of overall (public and private) enrollment with respect to public school price

[d]elasticity of private school probability with respect to private school price

[e]elasticity of public school probability with respect to private school price

[f]elasticity of probability of overall (public and private) enrollment with respect to private school price

Table 5: Policy Simulations--rural primary school enrollment and budgetary impacts

Policy	(1) Public primary	(2) Private primary	(3) All primary	(4) Proportional enrollment change (all primary)	(5) Cost to public sector (000s Fmg)	(6) Proportional change in public sector recurrent costs[c]	(7) Proportional change in public sector recurrent plus capital costs[c]
	Change in mean enrollment rate						
Add teachers/reduce multigrade classes by 50%							
multigrade school sample only	0.06	-0.007	0.05	0.10	84,246 - 151,473 [a]	0.11	0.10 - 0.18 [a]
All sample	0.04	-0.004	0.03	0.06			
School consolidation with multigrade elimination							
for distance between fokontany = 2 km							
multigrade school sample only	0.04	-0.005	0.04	0.07	67,284	0.00	0.08
All sample	0.03	-0.003	0.02	0.04			
for distance between fokontany = 3 km							
multigrade school sample only	0.01	-0.001	0.01	0.01	67,366	0.00	0.08
All sample	0.01	-0.001	0.00	0.01			
Private school construction							
for distance between fokontany = 3 km							
sample initially lacking private school	-0.08	0.126	0.04	0.09	102,704	0.00[b]	0.12[b]
All sample	-0.06	0.093	0.03	0.06			
for distance=3 km, fees=1/2 mean for existing private schools							
sample initially lacking private school	-0.11	0.173	0.06	0.13	107,158	0.00[b]	0.13[b]
All sample	-0.08	0.129	0.05	0.09			

Notes:

[a] Low estimate assumes no classroom construction, high estimate assumes an additional room is constructed in each school getting a new teacher.

[b] Assumes government pays only for construction of the new schools.

[c] Relative to sum of estimated initial public recurrent or total expenditures on primary education in all sample communities, calculated as the initial reported number of primary students in the sample public schools times per student recurrent and total unit costs reported in World Bank (2002).

Unit costs used in simulations are as follows (in 000s 1994 Fmg, $US 1= 1914 Fmg): teachers, 2,300 per year; classroom construction (including blackboard and benches), 16,780; supplies/other variable costs per student,7.5; teacher training, 1,020 per year x 2 years. Source: MENRS, direct communication or as reported in World Bank (2002). Room construction and teacher training costs are annualized over a lifetime of 20 years using a social discount rate of .10.

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Table 6: Distributional impacts of policy changes: changes in overall (public and private) primary enrollment probabilities by quintile

Quintile	Add teachers/reduce multigrade by 50%			Reduce multigrade by 50% and increase public fees 2000 Fmg			Private school construction			Private school construction, fees=1/2 mean		
	Pr 1[a]	Pr 2[a]	Pr 2 - Pr 1[a]	Pr 1[a]	Pr 2[a]	Pr 2 - Pr 1[a]	Pr 1[a]	Pr 2[a]	Pr 2 - Pr 1[a]	Pr 1[a]	Pr 2[a]	Pr 2 - Pr 1[a]
1	0.40	0.43	0.031	0.40	0.41	0.005	0.40	0.42	0.016	0.40	0.43	0.029
enroll share/child pop. share	*0.77*	*0.78*	*0.97*	*0.77*	*0.76*	*0.38*	*0.77*	*0.76*	*0.50*	*0.77*	*0.76*	*0.62*
2	0.53	0.56	0.036	0.53	0.53	0.006	0.53	0.55	0.021	0.53	0.57	0.042
enroll share/child pop. share	*1.01*	*1.02*	*1.13*	*1.01*	*1.00*	*0.46*	*1.01*	*0.99*	*0.66*	*1.01*	*1.00*	*0.89*
3	0.51	0.55	0.036	0.51	0.53	0.022	0.51	0.56	0.047	0.51	0.57	0.064
enroll share/child pop. share	*0.98*	*0.99*	*1.13*	*0.98*	*1.00*	*1.69*	*0.98*	*1.01*	*1.47*	*0.98*	*1.01*	*1.36*
4	0.61	0.64	0.028	0.61	0.63	0.021	0.61	0.66	0.049	0.61	0.67	0.058
enroll share/child pop. share	*1.18*	*1.16*	*0.88*	*1.18*	*1.19*	*1.62*	*1.18*	*1.20*	*1.53*	*1.18*	*1.18*	*1.23*
5	0.72	0.74	0.022	0.72	0.73	0.016	0.72	0.77	0.049	0.72	0.78	0.058
enroll share/child pop. share	*1.38*	*1.34*	*0.69*	*1.38*	*1.38*	*1.23*	*1.38*	*1.39*	*1.53*	*1.38*	*1.37*	*1.23*
All	0.52	0.55	0.032	0.52	0.53	0.013	0.52	0.55	0.032	0.52	0.57	0.047
	1.00	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*

Notes:

Results for full sample of children age 6 to 12.

[a] Average predicted enrollment probabilities before *(Pr 1)* and after (Pr 2) the policy change. Figures in italics show the quintile rural enrollment share divided by the quintile share of the rural school age population.

[b] Average change in enrollment probabilities. Figures in italics show the quintile share in the change in rural enrollments divided by quintile share of the rural school age population.

Table 7: Simulations of 50% reduction in multigrade classes combined with fee increases in public primary schools: Enrollment and budgetary impacts

		Policy				
		Reduce multigrade by 50% and raise annual public school fees by Fmg:				
	None[a]	0	1000	2000	5000	7500
Public primary enrollment probabilities						
1st quintile	0.32	0.38	0.36	0.35	0.31	0.28
5th quintile	0.49	0.54	0.53	0.53	0.51	0.50
All	0.43	0.48	0.47	0.46	0.43	0.40
Overall primary enrollment probabilities						
1st quintile	0.37	0.41	0.40	0.39	0.35	0.32
5th quintile	0.63	0.66	0.66	0.66	0.65	0.64
All	0.49	0.54	0.53	0.52	0.49	0.47
Cost to public sector (000s Fmg)[b]	0	151,473	140,860	130,777	103,559	84,141
Proportional change	0.00	0.18	0.17	0.16	0.12	0.10

Notes:

Shows changes in enrollments in sample of communities with multigrade teaching in public schools. Fee increases are imposed across the board on all public schools.

[a] Current predicted enrollment

[b] Costs include room construction in each school getting a new teacher (see notes to Table 5). Proportional changes in costs are relative to annual public recurrent and investment primary schooling expenditures in sample communities.